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Design and Application of Marionette Tangram: An Educational Teaching Media for Mathematics and Social Science Learning Process in Elementary Schools

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Abstract Teaching media is one of the important things in the learning process. It can stimulate and motivate elementary school students to learn the materials in the learning process. Marionette Tangram is an educational teaching media for elementary school students which can be used in geometry in mathematics and history subjects. This research was a developmental research using the 4D (four D) model of Thiagarajan. This paper summarizes how to define, design, develop, disseminate and apply the Marionette Tangram. Needs analysis of the media was conducted in the “define” phase. The prototype of the educational teaching media was created in the “design” phase. The experiment was carried out in the “develop” phase. In the dissemination phase, information related to the instructions on how to use the media was given to the teachers in many schools. The last phase was to register the copyright of Marionette Tangram media at the Ministry of Law and Human Rights of the Republic of Indonesia. The results of this research show that Marionette Tangram is an innovative educational teaching media because it is formed from cultural values and can be used in the learning process as a teaching aid for mathematics and history subjects. Furthermore, it can be categorized into valid criteria; and the instructional application is effective.

Keywords Marionette Tangram, Educational Teaching Media, Elementary School

1. Introduction

Elementary school curriculum in Indonesia is using thematic approach. Thematic approach is a learning approach that integrates various competencies from

various subjects into a certain theme ([1], [2], [3]). This learning approach has an actual theme that is close to the students and exists in their daily life. This theme becomes a unifying material that is diverse from various subjects. Implementation of integrated thematic learning model in the 2013 curriculum was strengthened by the use of scientific approach. In the learning activities based on scientific approach, students are required to think scientifically to construct a concept or principle. Stages of learning activities using the scientific approach include observing, asking questions, trying/ gathering information, reasoning/ associating, and communicating [4]. Elementary school students who are at the concrete level ([5], [6]) need concrete objects that can be held, felt and manipulated in order to find concepts. Therefore, appropriate teaching methods need to be designed relevant to their cognitive level.

Educational teaching media are tools in the learning process to connect the materials ([7], [8]). Media is something that can make the students motivated in the learning process [9]. Marionette Tangram is one media from Tangram’s puppet which is controlled using wires. This media supports the thematic learning process especially for mathematics and social sciences that can build the students’ character education.

2. Materials and Methods

This research was a developmental research using the 4D model of Thiagarajan (Define, Design, Develop and Dissemination) [10]. The instruments of the research consist of: (1) Marionette Tangram validation questionnaire by the experts in content, (2) Marionette Tangram validation questionnaire by the experts in media, (3) Marionette Tangram validation questionnaire by

teachers, and (4) student questionnaire. Data analysis was conducted qualitatively and quantitatively using Likert Scale ([11], [12]). Validation score consists of four categories: (4) valid, (3) fairly valid, (2) less valid and (1) not valid. Score of the data is converted into percentage [13]. Table 1 below presents the validity criteria that are converted into percentage.

Table 1. Validity Criteria

Percentage	Validity Criteria	Description
81 – 100	Strongly Valid	Not revised
61 – 80	Valid	Not revised
41 – 60	Fairly valid	Revised
21 – 40	Less valid	Revised
0 – 20	Not valid	Revised

The design of Marionette Tangram development is presented in Figure 1 below.

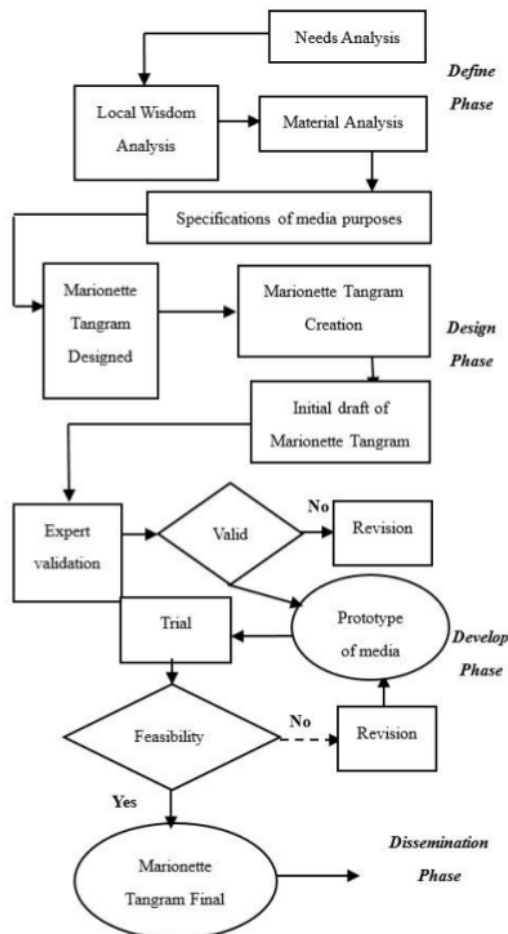


Figure 1. Marionette Tangram Development

3. Results and Discussion

3.1. Define Phase

In this phase, a preliminary study was carried out in the form of a literature study and needs analysis of the media.

3.1.1. Literature Study

The literature study is about learning media, material content in thematic learning process especially mathematics (the characteristic of plane), social sciences (history) and local wisdom.

3.1.2. Needs Analysis of Media

The activities were performed using requirement analysis regarding whether the learning media was needed to be developed or not. Some findings in this phase included student response during the learning process. The data of student questionnaire results can be seen in table 2.

Table 2 indicates the following learning activities: 1) thematic learning process was conducted using speech method, 2) thematic learning process was not supported by an appropriate and interesting learning media, 3) the learning media was still limited to some materials in some lessons, 4) the learning media based on local wisdom was needed to bring students closer to their local wisdom, 5) students agreed to use learning media in the learning process, and 6) students were not familiar with learning media based on local wisdom like Marionette Tangram.

Table 2. Student Questionnaire on Preliminary Study

No	Indicators	Percentage
1	Thematic learning process using speech method	90%
2	Thematic learning process should use innovative learning method in addition to speech and book	85%
3	Thematic learning process using innovative and interesting educational teaching media	35%
4	Students agree to use learning media in the learning process	88%
5	Students are familiar and interested to the local wisdom	32%
6	Students have used educational teaching media based on local wisdom	0%

Table 2 shows that educational teaching media is necessary to improve the quality of the thematic learning process. One of the important things in thematic learning process is to establish the learning tools and media in addition to the learning approach, discovery of the concept and student interaction [14]. The media also improves student motivation and their participation in the class discussion [15]

3.2. Design Phase

In the define phase, the appropriate teaching media was designed. Local wisdom related to the theme was the basis for making the media. Marionette Tangram was designed from Tangram puppets. Marionette is a puppet with wires that is controlled from above [16], while Tangram is a truncated puzzle which is divided into 7 geometrical shapes called tans [17]. Figure 2 below describes the design.



Figure 2. The design of Marionette Tangram

The design described the activities in Bulusan story (a local wisdom from Kudus, Central Java, Indonesia). *Bulusan* story is related to the cultural diversity theme in the thematic learning process for the fourth-grade students in elementary school. The following steps show the instructions to use the media.

1. The teacher motivates students and encourages students' curiosity by using media in learning.
2. The teacher divides students into groups and each group is asked to share their initial knowledge related to cultural traditions that exist in the environment around the students. "Try to identify what cultural traditions exist in the environment around us!" (In this case was Kudus area). The students' answers include the tradition of 'dandangan', 'sewu kupat', and 'Bulusan'.
3. The teacher conveys that on this occasion the 'Bulusan' tradition will be studied
4. Students are asked to share their initial knowledge related to the 'Bulusan' tradition. "Students, you mentioned earlier that one of our cultural traditions is the *Bulusan* tradition. Tell me about your knowledge related to this tradition. (students will tell their initial knowledge related to the tradition).
5. The teacher tells the story by using Marionette Tangram as the *Bulusan's* educational media.
6. Students are asked to retell the tradition and demonstrate it using the media.

7. Students are asked to try to identify the noble values of history, religious and character contained in the story and the cultural traditions.
8. Teaching geometry using Marionette Tangram. Students are asked to identify some of the plane shapes that exist in the media such as square, rectangle, triangle, rhombus, parallelogram and trapezoid. "Look at the back of the Marionette Tangram in *Bulusan*, What do you find?" (Combining several plane figures/two dimensional figure). "Try to mention any plane shapes that build the media" (The conditional answer corresponds to the plane figure on the back of the characters).
9. Students are asked to identify the characteristics of the plane shapes that form the Marionette Tangram in one part of the storyline. Try to identify the nature of the plane figure that builds the Marionette Tangram in *Bulusan* "(the conditional answer is by the characteristics of the plane).
10. Students' answers related to the characteristics of the plane figures are corrected and matched with the following Table 3.

Table 3. The Plane Characteristics

No	Plane (Two Dimensional Figure)	Characteristics
1	Square	It has four equal lengths and four equal angles (90°)
2	Rectangle	It has two pairs of sides of equal length and four right angles
3	Triangle	It has three sides, a base and height and three acute angles
4	Rhombus	It has four sides, two sides facing the same length, and two different sizes of diagonals
5	Parallelogram	It has four sides, two sides facing the same length, two different sizes of diagonals, and two kinds of base and height sizes
6	Trapezoid	It has four sides, a pair of parallel sides, two kinds of base size and height, the height line is a line that is perpendicular to the base

3.3. Develop Phase

The results of the development phase are expert validation for the media and the results of the students' questionnaires. There are five content validators and two media validators who assess the media. Table 4a and Table 4b present the results of the expert validation. Table 4c shows the media assessments from practitioners and users, and table 4d presents students' questionnaire results.

Table 4a and 4b show that the development of Marionette Tangram is in the strongly valid criteria. Based on this results, it can be concluded that the media is feasible to use in learning. The scope of the materials and content accuracy become one of the important things in media development. Instructional content is one of the

factors in learning [18].

Table 4c and 4d show that the application of the media is in strongly valid and valid criteria. Teachers and students declare that the media increases their motivation and curiosity. Moreover, many research show that media can increase student motivation in learning [19].

Table 4a. Content Expert Results

No	Indicators	Percentage	Criteria
1	Content Completeness		
	Scope of Competencies	96%	Strongly valid
	Scope of Indicators	97%	Strongly valid
2	Content Accuracy		
	Theme Suitability	98%	Strongly valid
	Mathematics Content Suitability	97%	Strongly valid
	History Content Suitability	98%	Strongly valid

Table 4b. Media Expert Results

No	Indicators	Percentage	Criteria
1	Design and Size	92%	Strongly valid
2	Configuration	94%	Strongly valid
3	Materials and Color	90%	Strongly valid
4	Media Utilization	98%	Strongly valid
5	Packaging	90%	Strongly valid

Table 4c. Teacher/Practitioner Results

No	Indicators	Percentage	Criteria
1	Instruction for use in learning process	90%	Strongly valid
2	Easiness of use	80%	Valid
3	Material content covers competencies	90%	Strongly valid
4	Content accuracy	92%	Strongly valid
5	Motivate the students to construct their knowledge	90%	Strongly valid
6	Generate students' interest	95%	Strongly valid

Table 4d. Students Questionnaire Results

No	Indicators	Percentage	Criteria
1	Instruction for use is easy to understand	85%	Strongly valid
2	Easiness of use	81%	Strongly valid
3	Media increases motivation	98%	Strongly valid
4	Media makes the students happy and interested	95%	Strongly valid
5	Media encourages curiosity	80%	Valid

3.4. Disseminate Phase

The dissemination phase is the phase of disseminating information about the Marionette Tangram media. This dissemination was carried out in Kudus, Central Java,

Indonesia. Moreover, the media copyright has been registered with the copyright registration number 000123371.



Figure 3. The dissemination of Marionette Tangram Media

4. Conclusions

Marionette Tangram as an educational teaching media was considered valid and visible to use in the thematic learning process. The media can be used to teach geometry especially in the topic of plane characteristics. There are six planes in Marionette Tangram. The media can also be used to teach social sciences related to history and character values.

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